Center for the Advancement of Population Assessment Methodology (CAPAM)

Biannual Report

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NOAA/IATTC/SIO
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Background

The Center for the Advancement of Population Assessment Methodology (CAPAM) was formally established and began project work in February 2013. The CAPAM's mission involves research, education, and outreach that addresses animal population dynamics, models, and assessments associated with marine fishery resources. Presently, primary CAPAM staff includes: three principal investigators representing the three founding institutions, Mark Maunder (IATTC), Paul Crone (NOAA), and Brice Semmens (SIO); two research associates, Jenny McDaniel (NOAA) and Devon O'Meara (SIO); and one research scientist, Juan Valero (CAPAM). Graduate students and post-doctoral researchers (SIO) are also involved with CAPAM in various capacities. Only Juan Valero's research position and some graduate research work are supported directly through CAPAM funds; all other appointments, support, and services are provided by the main institutions. At the onset, the highest priority was to establish an infrastructure for CAPAM that would allow appropriate and efficient processing of funds for supporting project work conducted by staff and collaborators, including salaries, purchasing computers, travel-related costs, hosting visiting scientists, coordinating technical workshops/working groups/short courses, and website development. Much work remains for streamlining this effort, given the different administrative requirements and stipulations. Finally, general information regarding CAPAM operations and deliverables to date is presented in Appendix A.

Programs and Projects

Good Practices in Stock Assessments Modeling Program

Presently, a major program for CAPAM is modeling research addressing the theories, estimators, and assumptions used in contemporary integrated stock assessment models, whereby 2-3 year research projects are conducted on important topics/parameterizations associated with developing stock assessments used to provide management advice on exploited marine populations.

Selectivity Project

The first project has focused on modeling selectivity in stock assessments. Selectivity research by CAPAM staff and collaborators includes modeling work on functional forms (splines), alternative composition/selectivity choices and management, spatial structure, time-varying vs. -invariant selectivity, and diagnostics.

- Special Issue Publication: A special issue in the journal *Fisheries Research* resulting from the March 2013 workshop on selectivity is published. The special issue contains 20 papers and a preface. CAPAM staff and visiting scientists are involved in six of the publications. (see http://www.sciencedirect.com/science/journal/01657836/158).

- Good Practices Guide: Past and current selectivity research needs to be synthesized and included in the *Good Practices Guide* (GPG-selectivity). This will be accomplished by a formal working group that includes USA and international participation. The working group (WG) members have been selected and the first meeting was held via the internet in July 2014 using the online forum WebEx. The primary goal of the meeting was to discuss the approach for creating the selectivity section. The meeting resulted in the following recommendations: (1) the CAPAM staff will produce a preliminary draft of the GPG-selectivity that will be distributed to the WG for comments and suggested revisions; (2) based on the initial WG review, the CAPAM staff will produce a second draft of the GPG-selectivity (this version will also be made available for public review and comments); (3) a second (WebEx) meeting will be held to discuss completion and documentation of the final version of the GPG-selectivity; (4) the CAPAM staff will then prepare a final version that will be distributed broadly (the target date for the final GPG-selectivity is December 2014).
- Visiting Scientists: Chris Francis, recently retired from New Zealand's National Institute of Water and Atmospheric Research, spent six-weeks from February to March, 2014 at the SWFSC and conducted research on data weighting in stock assessments. David Sampson from Oregon State University spent three-weeks from April to May 2014 at the SWFSC and conducted research on time-varying selectivity (research summary of his visit can be found at http://www.capamresearch.org/sites/default/files/Sampson-Report_for_CAPAM_Visiting_Scientist-2014.pdf).

Growth Project

The next project will focus on modeling growth in stock assessments. Research on this topic began earlier in 2014 and a workshop is scheduled for November 3-7, 2014 in La Jolla at the new SWFSC. Keynote speakers have been confirmed for the workshop. Papers from the workshop will be published in a special issue of the journal *Fisheries Research* (two papers have already been submitted for publication).

Education and Outreach

The CAPAM personnel are involved with various projects supporting population dynamics education and mentoring. Notably, CAPAM principal investigators, researchers, and advisory panel members have participated in the education and enrichment of many undergraduate and graduate students through mentoring and formal teaching. These efforts have facilitated graduate student publications, participation in CAPAM workshops and the WCSAM, along with training opportunities in assessment tools and techniques. The CAPAM education programs are tightly aligned with the new NOAA Quantitative Ecology and Socioeconomics Training (QUEST) program. The QUEST mission is to enhance education and training for the next generation of stock assessment researchers, ecosystem scientists, and economists.

Introduction to Fisheries Stock Assessment Short Courses

CAPAM Staff in collaboration with scientists from NOAA and other institutions have organized and conducted short-courses on Fisheries Stock Assessment in the US and Internationally. These included courses in Miami, January 27-29, 2014 at the University of Miami; Argentina, February 17-21, 2014, at the Instituto Nacional de Investigacion y Desarrollo Pesquero (INIDEP); and Chile, March 3-7, 2014 at Universidad de Concepcion. Dr. Valero's travel costs to teach the courses in Chile and Argentina were supported by NOAA Fisheries International Science Strategy. Dr Maunder's travel costs to teach the courses in Miami were supported by the University of Miami. The materials developed for the courses in Argentina and Chile served as the basis for a stock assessment class lead by Steve Teo (SWFSC) in La Jolla, 24 June to July 1, 2014.

Undergraduate and Graduate level Formal Course Instruction

Co-PI Brice Semmens taught two quantitative/modeling courses as part of regular UCSD curriculum offerings during the review period: Statistical Methods in Marine Biology (SIO 187, undergraduate), and Introduction to Bayesian Population Analysis (SIO 296, graduate). The undergraduate statistics course is a core requirement for those students majoring in Marine Biology at SIO. The graduate level course broached topics in mark-recapture analysis, hierarchical models, and state-space time-series analysis.

Graduate Student and Postdoctoral Research Mentoring

Graduate student and post-doctoral research associated with CAPAM programs has progressed substantially, in large part due to the active support, guidance, and mentoring from CAPAM personnel. Below we highlight recent research activities in this regard.

White Seabass Assessment Project

A collaborative project is underway with the Pfleger Institute of Environmental Research (PIER) and California Department of Fish and Wildlife (CDFW) on a white seabass (*Atractoscion nobilis*) stock assessment that will be formally reviewed and ultimately, used to assist management of the coastal population off southern California. Motivation for CAPAM's involvement with this project was to assist SIO's education-related goals to prepare students for stock assessment employment, and to develop joint projects that address marine resources actively managed by the state of California. The CAPAM research scientist, Dr. Juan Valero is currently working with Scripps Institution of Oceanography (SIO) graduate student Lynn Waterhouse on this stock assessment. The assessment is expected to be completed and reviewed by Fall/Winter 2014.

Data-poor Assessment Methodologies for Aggregating Species

First year SIO graduate student Brian Stock is applying data-poor assessment methodologies for aggregating species where catch data are absent, as is often the case when conservation is the primary management concern. As part of his PhD research, Brian is extending a recently

published method of estimating spawning potential ratio (SPR) for use on non-catch length-composition data. He plans to test the improved method using previously collected data from a Nassau grouper spawning aggregation.

Coastal Angler Tagging Cooperative
SIO graduate student Lyall Bellquist is working with the recreational fishing community, the California Department of Fish and Game, and the San Diego Oceans Foundation to implement an assessment of *Paralabrax* spp. populations, vital rates, and movement patterns. The project aims to generate important demographic rate parameters used in stock assessments (e.g., mortality and growth). This information will help clarify *Paralabrax* spp. status and trends for the purpose of identifying appropriate population monitoring metrics for adaptive management.

Phenotypic variation and selective mortality as major drivers of recruitment variability in fishes
Former CAPAM/SIO postdoctoral researcher Darren Johnson focused on methods for modeling recruitment variability as a function of phenotypic variation and selective mortality during his tenure at SIO. This work culminated in a review article in *Ecology Letters*. The paper, recommended by the Faculty of 1000, includes a review of the literature on selective mortality and defines an analytical framework that accounts for variation in selection in addition to describing the amount of selective mortality experienced by different cohorts recruiting to a single population. This past Fall, Darren was hired as an assistant professor of quantitative ecology at California State University, Long Beach, in September 2013.

Research mentoring and collaborative work for CAPAM's Growth Workshop
CAPAM's research scientist Juan Valero is working with graduate students from the University of Washington, Simon Fraser University and University of British Columbia in collaboration with scientists from the NWFSC in Seattle. The goal of this collaborative work is to provide education and mentoring opportunities for upper level graduate students interested in learning quantitative stock assessment methods. At least 3 papers are expected to be presented at the CAPAM's Growth workshop and submitted for publication.

APPENDIX A

Visiting Scientists

- Dr. Sheng-Ping Wang. Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, Keelung, Taiwan. February 24 to March 24, 2013. Funded by the International Seafood Sustainability Foundation (ISSF).
- Dr. Chris Francis. Recently retired from New Zealand's National Institute of Water and Atmospheric Research. Six weeks (February-March 2014).
- Prof. David Sampson. Oregon State University. Three weeks (April-May 2014). See CAPAM website (http://www.capamresearch.org/sites/default/files/Sampson-Report_for_CAPAM_Visiting_Scientist-2014.pdf).

Presentations, Short Courses, Collaborative Work

- CAPAM PI Mark Maunder taught the course "Integrated Analysis Using Stock Synthesis: appropriate use of multiple data sets" in Miami, January 27-29, 2014 at the University of Miami.
- CAPAM Research Scientist Dr. Juan Valero taught a stock assessment course using the stock assessment platform Stock Synthesis in Argentina, February 17-21, 2014, at the Instituto Nacional de Investigacion y Desarrollo Pesquero (INIDEP).
- CAPAM Research Scientist Dr. Juan Valero taught a stock assessment course using the stock assessment platform Stock Synthesis in Chile, March 3-7, 2014 at Universidad de Concepcion.
- CAPAM Research Scientist Dr. Juan Valero taught the course Introduction to Fisheries Stock Assessment on December 9-13, 2013 at Scripps Institution of Oceanography, La Jolla CA, USA.
- CAPAM PI Mark Maunder attended the Workshop on Stock Assessment of Peruvian Small Pelagics as an invited expert, September 2-6, 2013, at the Instituto del Mar del Perú in Lima, Peru. He gave a presentation titled, "The current status of fisheries stock assessment."
- Presentations at the World Conference on Stock Assessment Methods (WCSAM) held in Boston July 15-19, 2013.
  - **Maunder, M. N.** *Challenges for fisheries stock assessment* (Keynote presentation).
  - **Crone, P.R.**, **J.L. Valero, M.N. Maunder, B.X. Semmens**. *Selectivity: theory, estimation, and application in fishery stock assessment models - Workshop overview.*
  - Hurtado-Ferro, F., **J.L. Valero**, C. Szuwalski, K. Johnson, C. McGilliard, C. Monahan, R. Licandeo, M. Muradian, A. Whitten, K. Ono, K. Vert-Pre, S. Anderson, C. Cunningham. *What generates retrospective patterns in statistical catch-at-age assessment models?*

- Johnson, K., C. Monnahan, C. McGilliard, K. Vertpre, **J.L. Valero**, C. Szuwalski, R. Licandeo, M. Muradian, A. Whitten, K. Ono, S. Anderson, F. Hurtado Ferro, C. Cunningham. *Time-varying natural mortality in fisheries stock assessment models: identifying a default approach.*
- Ono, K., K. Vert-Pre, S. Anderson, C. Cunningham, **J.L. Valero**, C. Szuwalski, K. Johnson, C. McGilliard, C. Monahan, F. Hurtado Ferro, R. Licandeo, M. Muradian, A. Whitten. *Better data yields better yields?: why the type, quantit,y and quality of data matters in fisheries stock assessments.*
- **Valero, J.L.,** I. G. Taylor, **M.N. Maunder, P.R. Crone**. *Using simulation analysis to evaluate the use of cubic spline selectivity in integrated stock assessments.*
- Whitten, A., C. McGilliard, **J.L. Valero**, S. Anderson, C. Cunningham, F. Hurtado Ferro, K. Johnson, R. Licandeo, C. Monnahan, M. Muradian, K. Ono, C. Szuwalksi, K. Vertpre. *Lessons Learned from a Stock Assessment Simulation Study.*

Publications (CAPAM staff in bold)

2013

Crone, P. R., M.N. Maunder, J.L. Valero, J.D. McDaniel, B.X. Semmens (Editors). 2013. Selectivity: theory, estimation, and application in fishery stock assessment models. Workshop Series Report 1. Center for the Advancement of Population Assessment Methodology (CAPAM). NOAA/IATTC/SIO, 8901 La Jolla Shores Dr., La Jolla, CA 92037. 46 p.

Haltuch, M.A., K. Ono, **J.L. Valero**. 2013. Status of the U.S. petrale sole resource in 2012. Pacific Fishery Management Council. 7700 Ambassador Place NE, Suite 200, Portland, OR 97220.

Maunder, M.N., R.B. Deriso. 2013. A stock–recruitment model for highly fecund species based on temporal and spatial extent of spawning. Fisheries Research 146: 96-101.

2014

Aires-da-Silva, A., **M.N. Maunder**, K.M. Schaefer, D.W. Fuller. *In Press*. Improved growth estimates from integrated analysis of direct aging and tag-recapture data: an illustration with bigeye tuna (*Thunnus obesus*) of the eastern Pacific Ocean with implications for management. Fisheries Research.

Anderson, S. C., C.C. Monnahan, K.F. Johnson, K. Ono, **J.L. Valero**. 2014. ss3sim: An R package for Fisheries stock assessment simulation with Stock Synthesis. PLoS ONE. 9(4): e92725.

Carvalho, F., R. Ahrens, D. Murie, J.M. Ponciano, A. Aires-da-Silva, **M.N. Maunder,** and F. Hazin. 2014. Incorporating specific change points in catchability in fisheries stock assessment models: An alternative approach applied to the blue shark (*Prionace glauca*) stock in the south Atlantic Ocean. Fisheries Research 154: 135-146.

Crone, P.R., J.L. Valero. 2014. Evaluation of length- vs. age- composition data and associated selectivity assumptions used in stock assessments based on robustness of derived management quantities. Fisheries Research, 158: 165-171.

Deroba, J.J., D.S. Butterworth, R.D. Methot, J.A.A. De Oliveira, C. Fernandez, A. Nielsen, S. X. Cardin, M. Dickey-Collas, C.M. Legault, J. Ianelli, **J.L. Valero**, C.L. Needle, J.M. O'Malley, Y.J. Chang, G.G. Thompson, C. Canales, D.P. Swain, D.C.M. Miller, N.T. Hintzen, M. Bertignac, L. Ibaibarriaga, A. Silva, A. Murta, L.T. Kell, C.L. de Moor, A.M. Parma, C.M. Dichmont, V.R. Restrepo, Y. Ye, E. Jardim, P.D. Spencer, D.H. Hanselman, J. Blaylock, M. Mood, P.J.F. Hulson. *In Press.* Simulation testing the robustness of stock assessment models to error: some results from the ICES Strategic Initiative on Stock Assessment Methods. ICES Journal of Marine Science.

Hurtado-Ferro, F., C. Szuwalski, J.L. **Valero**, S. Anderson, C. Cunningham, K. Johnson, R. Licandeo, C. McGilliard, C. Monnahan, M. Muradian, K. Ono, K. Vert-pre, A.R. Whitten. *In Press*. What generates retrospective patterns in statistical catch-at-age stock assessment models?. ICES Journal of Marine Science.

Hyun, S.Y., **M.N. Maunder**, B.J. Rothschild. *In Press*. Importance of modeling hetero-scedasticity of survey index data in fishery stock assessments. ICES Journal of Marine Science.

Johnson, D.W.K. Grorud-Colvert, S. Sponaugle, **B.X. Semmens.** 2014. Phenotypic variation and selective mortality as major drivers of recruitment variability in fishes. Ecol. Lett., 17(6), 743-55.

Johnson, K.F., C.C. Monnahan, C.R. McGilliard, K.A. Vert-pre, S.C. Anderson, C.J. Cunningham, F. Hurtado-Ferro, R. Licandeo, M. Muradian, K. Ono, C.S. Szuwalski, **J.L. Valero**, A.R. Whitten, A.E. Punt. 2014. Time-varying natural mortality in fisheries stock assessment models: identifying a default approach. ICES J. Mar. Sci. DOI:10.1093/icesjms/fsu055.

Lee, H. H., K.R. Piner, R.D. Methot, **M.N. Maunder**. 2014. Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: An example using blue marlin in the Pacific Ocean. Fisheries Research, 158: 138-146.

Maunder, M.N., K.R. Piner. 2014. Contemporary fisheries stock assessment: many issues still remain. ICES Journal of Marine Science. doi: 10.1093/icesjms/fsu015.

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Ono, K., R. Licandeo, M.L. Muradian, C.R. Cunningham, S.C. Anderson, F. Hurtado-Ferro, K.F. Johnson, C.F. McGilliard, C.F. Monnahan, C.S. Szuwalski, **J.L. Valero**, K.A. Vert-pre, A.R. Whitten, A.E. Punt. 2014. The importance of length and age composition data in statistical age-structured models for marine species. ICES Journal of Marine Science. DOI: 10.1093/icesjms/fsu007.

Sippel, T., J.P. Eveson, B. Galuardi, C. Lam, S. Hoyle, **M. Maunder,** P. Kleiber, F. Carvalho, V. Tsontos, S.L.H. Teo, A. Aires-da-Silva, S. Nicol. *In Press.* Using movement data from electronic tags in fisheries stock assessment: A review of models, technology and experimental design. Fisheries Research.

Wang, S.P., M.N. Maunder, A. Aires-da-Silva. 2014. Selectivity's distortion of the production function and its influence on management advice from surplus production models. Fisheries Research, 158: 181-193.

Wang, S.P., M.N. Maunder, K.R. Piner, A. Aires-da-Silva, H.H. Lee. 2014. Evaluation of virgin recruitment profiling as a diagnostic for selectivity curve structure in integrated stock assessment models. Fisheries Research, 158: 158-164.

Wang, S.P., **M.N. Maunder**, T. Nishida, T., Y. R. Chen, *In press.* Influence of model misspecification, temporal changes, and data weighting in stock assessment models: Application to swordfish (*Xiphias gladius*) in the Indian Ocean. Fisheries Research.

Waterhouse, L., D.B. Sampson, **M.N. Maunder, B.X. Semmens.** 2014. Using areas-as-fleets selectivity to model spatial fishing: Asymptotic curves are unlikely under equilibrium conditions. Fisheries Research, 158: 15-25.

Special Issue on Selectivity (*Fisheries Research*)

Butterworth, D.S., R.A. Rademeyer, A. Brandão, H.F. Geromont, S.J. Johnston. 2014. Does selectivity matter? A fisheries management perspective. Fisheries Research, 158: 194-204.

Clark, W.G. 2014. Direct calculation of relative fishery and survey selectivities. Fisheries Research, 158: 135-137.

Crone, P.R., J.L. Valero. 2014. Evaluation of length- vs. age- composition data and associated selectivity assumptions used in stock assessments based on robustness of derived management quantities. Fisheries Research, 158: 165-171.

Hulson, P.J.F, D.H. Hanselman. 2014. Tradeoffs between bias, robustness, and common sense when choosing selectivity forms. Fisheries Research, 158: 63-73.

Hurtado-Ferro, F., A.E. Punt, K.T. Hill. 2014. Use of multiple selectivity patterns as a proxy for spatial structure. Fisheries Research, 158: 102-115.

Ichinokawa, M., H. Okamura, Y. Takeuchi. 2014. Data conflict caused by model mis-specification of selectivity in an integrated stock assessment model and its potential effects on stock status estimation. Fisheries Research, 158: 147-157.

Lee, H.H., K.R. Piner, R.D. Methot, **M.N. Maunder**. 2014. Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: An example using blue marlin in the Pacific Ocean. Fisheries Research, 158: 138-146.

Legault, C.M. 2014. The ability of two age composition error distributions to estimate selectivity and spawning stock biomass in simulated stock assessments. Fisheries Research, 158: 172-180.

Martell, S.J.D., I.J. Stewart. 2014. Towards defining good practices for modeling time-varying selectivity. Fisheries Research, 158: 84-95.

Maunder, M.N., Crone, P.R., Valero, J.L., Semmens, B.X. 2014. Selectivity: Theory, estimation, and application in fishery stock assessment models. Fisheries Research, 158: 1-4.

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Punt, A.E., F. Hurtado-Ferro, A.R. Whitten. 2014. Model selection for selectivity in fisheries stock assessments. Fisheries Research, 158: 124-134.

Sampson, D.B. 2014. Fishery selection and its relevance to stock assessment and fishery management. Fisheries Research, 158: 5-14.

Schueller, A.M., E.H. Williams, R.T. Cheshire. 2014. A proposed, tested, and applied adjustment to account for bias in growth parameter estimates due to selectivity. Fisheries Research, 158: 26-39.

Sharma, R., A. Langley, M. Herrera, J. Geehan, S.Y. Hyun. 2014. Investigating the influence of length–frequency data on the stock assessment of Indian Ocean bigeye tuna. Fisheries Research, 158: 50-62.

Stewart, I.J., S.J.D. Martell. 2014. A historical review of selectivity approaches and retrospective patterns in the Pacific halibut stock assessment. Fisheries Research, 158: 40-49.

Thorson, J.T., I.G. Taylor. 2014. A comparison of parametric, semi-parametric, and non-parametric approaches to selectivity in age-structured assessment models. Fisheries Research, 158: 74-83.

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